

Cross-Fire - a grid platform to integrate geo-referenced Web Services for real-time risk management

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Fire propagation simulation tools are useful at different levels of forest fire management. From prescribed fire planning to fuel hazard assessment or to the development of fire suppression strategies on wildfires or even training activities. Nevertheless, real time use of such tools is still very limited among the operational authorities for several reasons: lack of good real time data, lack of training or even lack of confidence on the capabilities of actual systems, among others. Wildfire management is a relevant Civil Protection (CP) activity that involves many different and autonomous actors, from public bodies to research centres and should some how reach the general public as an information and alert system. It requires a fast and reliable risk management support system, with real-time or near real-time availability of critical geo-referenced data and settings-based forecasts for fire spreading. CP applications require a strict integration of human and physical resources that must be shared in a coordinated and effective way and be available for the whole emergency procedure.

The GRID and Virtual Organizations (VO) enable such integration by providing the coordination and the sharing of the available interconnected resources (computing, storage, communication, sensors and actuators) geographically scattered across national borders.

On the another hand, OGC (Open Geospatial Consortium) based geo-web services are being adopted worldwide, as the technology to support the development of complex distributed applications over grid platforms, to deal with data from many different sources, including meteorological stations and satellites. Recent work clearly showed the advantage of the OGC proposals for open standards for geospatial interchange formats, over past legacy formats and applications.

CROSS-Fire Approach

The CROSS-Fire project aims to develop a grid-based framework as a risk management decision support system for the civil protection authorities, using forest fires as the main case study and FireStation (Lopes et al, 1998) as the standalone application that simulates the fire spread over complex topography. The approach is based in an architecture that includes: information models, encodings, and metadata that represent the scientific knowledge associated

to FireStation execution models and standards to enable the discovery and access of Web services, data repository, sensor networks and data processing facilities.

The overall software development is made of several components: client applications, which request geo-referenced data and fire spread simulation, Spatial Data Infrastructures (SDI), which provide geo-referenced data, and the GRID, which gives support to the computational and data storage requirements.

CROSS-Fire uses EGEE (Enabling Grids for E-science project) to provide raw technological capability provision, including data management and storage, access to meta-data data bases and HPC (*High-Performance Computing*) and a Geospatial Information Infrastructure based on OGC-SWE Web Services to provide the access and management of remote geospatial data and meteorological data.

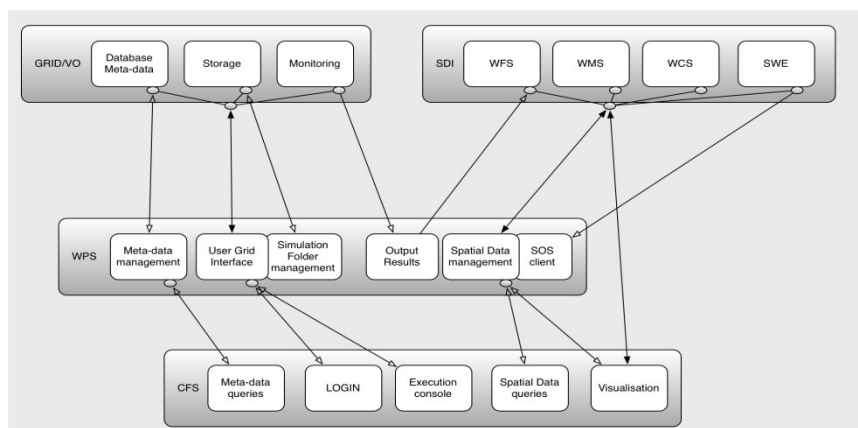
To give support to each of the above components, and using the norms afore mentioned, a web services layer was created, based on WPS (Web Processing Service). The use of web services allows different components to interact with each other in a standardised mode, acting each one as clients of the web services layer. It also allows the connection of heterogeneous clients, as long as they comply with the standards.

Cross-Fire Platform

The CROSS-Fire platform is composed of a central core, a WPS layer, and two external infrastructures: a SDI platform and the GRID. The core WPS is divided in three parts: Business Logic, Grid Services and Geospatial services. The Business Logic is an abstract layer configured to handle the specific algorithms that provide all the functionality of FireStation, namely forest fire propagation and suppression simulation, wind field calculation and fire weather index.

The Grid Services is the component that interfaces with the GRID infra-structure. Amongst its responsibilities one can find proxy delegation, job creation and management, and data movement to and from the GRID.

WPS serves as an interface to a wide range of distributed computing resources provides the mechanism to access the grid facilities for processing and data management and including all the algorithms, calculation, or model that operates on spatially referenced data, also mediating all the communication with the portal and other GUI clients, such as FireStation console (CFS).



The CROSS-Fire platform

Current development

The G-FireStation user interface that is currently under development is an open-source desktop with GIS and CAD capabilities that exploits an SDI client complying with OGC-WS and EU INSPIRE directives. It provides facilities to locate and access the spatial data infrastructure and to visualise the fire propagation, based on the native facilities of gvSig (www.gvsig.gva.es), it was also extended to support a OGC WPS client that mediate all the interactions with the core WPS service layer.

In another direction, a standard-based SDI layer Geo-server based is en being exploited to provide FS with static data, and to publish data for further processing. To provide FS with the dynamic data coming from sensors in weather stations (such as DAVIS Vantage Pro2) wean OGC-SWE compatible layer is being developed. The dynamic data includes meteorological information and satellite images.

The project also includes the design and implementation of a decision-support system based on a web portal where many players can connect, to request services through the core WPS core layer. IT will allow updating the input data required to estimate the risk of the natural hazard, or to access the past simulations to validate the predictions with actual field data.

Conclusions

Cross-Fire provides a general approach for the development of a Civil Protection application that requires not only the availability of high-performance computing resources and data management at remote Grid sites, but also the ability to access, to integrate, to analyze and present geospatial, available data repositories and sensor networks data across a distributed computing environment.

The approach allows different components to interact with each other in a standardised mode, acting each one as clients of the OGC WPS web services layer.

The use of WPS offering a modular addition of new facilities, algorithms and services to clients and users of an application as long as the requests conforms to OGC-SWE and EU/INSPIRE standards.

More recently, efforts are being made to integrate other types of spatial data, to work with data from satellites, such as Terra/Aqua, sensed by instrument sensors such as MODIS (see https://lpdaac.usgs.gov/lpdaac/products/modis_overview).

The platform may also be used to support new brands of CP applications, such as Flash floods, implemented as a new Application Business Logic component that responds to the specificities of the new application domain.

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